The Economic Importance and Value of Menhaden in The Chesapeake Bay Region

Year One Summary Report
RF/CF 07-02

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1.0 Introduction

1.1 Scope and Nature of Study

In 2007, the Virginia Secretary of Natural Resources, the Virginia Marine Resources Commission, and the Governor of Virginia initially requested a comprehensive assessment of the social and economic importance and value of menhaden to residents of the Chesapeake Bay region. The study "The Economic Importance and Value of Menhaden in The Chesapeake Bay Region" seeks to determine the social and market and non-market value of menhaden. The study has two broad objectives: (1) estimate and assess the economic importance of menhaden relative to water quality, biomass and abundance of major gamefish and commercial species in the region, the quality of recreational fishing and water-based sports, and the value of property in the region, and (2) determine the importance of the menhaden resource and fishery to the various coastal communities in the region.

The commercial fishery and the utilization of menhaden have been the sources of major conflict up and down the east coast since the 1800s. In 1888, Assemblyman Cromwell introduced a bill to prohibit fishing using menhaden nets in Raritan Bay, New York (The New York Times, 1888). Opposition to the fishing of menhaden with nets was based on concerns about bycatch of bluefish and weakfish, depletion of important prey for various gamefish, and the fact that menhaden were not used for human food but mostly for fertilizer. In 1889, Governor Ames of Massachusetts imposed a ban on the seining of menhaden in Massachusetts's waters, and especially in Buzzard's Bay. Opposition was primarily by recreational anglers and focused on the perceived value of menhaden to water quality and the abundance and biomass of various gamefish. In 1994, and up to the present period, there have been calls to ban or seriously restrict the harvesting of menhaden in the Chesapeake Bay, other bodies of water along the east coast, and in the coastal Atlantic Ocean.

Most of the requests to prohibit the commercial harvesting of menhaden focus on the industrial purse seine fishery rather than the other fisheries for menhaden (e.g., the pound net fishery for menhaden). Presently, nearly all states from Maine through Florida have some type of restriction on either purse seine fishing, mobile gear, or the taking of menhaden for reduction (fish meal and oil) purposes. Virginia, North Carolina, Massachusetts, and Maine have the least restrictive regulations on the commercial harvesting of menhaden. In contrast, several states have very restrictive regulations. Maryland, New Jersey, South Carolina, New Hampshire, Connecticut, Delaware, South Carolina, Georgia, and Florida, for example, prohibit purse seine fishing for menhaden in state waters. Objections to the industrial fishery are primarily based on the perceptions that the harvesting of menhaden reduces water quality; affects the abundance and health of major gamefish, other commercial species, and various marine mammals and sea birds; and since menhaden are not directly consumed as food by humans, the commercial harvesting of menhaden is simply morally wrong. Alternatively, there are numerous substitutes for meal and oil, and thus, it is unnecessary to harvest menhaden for reduction purposes.

Regardless of the question of whether or not is it morally alright to harvest menhaden for reduction purposes, there remains the basic issue, and that is, are menhaden more important to society in the water or being processed into bait, meal, and oil? Alternatively, what are the economic and social values of menhaden? Also, what is the economic importance of menhaden to the Chesapeake Bay region? Addressing the valuation questions requires extensive research on market and non-market valuation and social valuation. Addressing the question of economic importance requires a comprehensive assessment of the economic impacts, in terms of basic economic metrics, of the commercial menhaden fishery and related industries (e.g., the economic impacts of menhaden as crab and sport fishing bait). Determining the social value of menhaden requires a comprehensive assessment of all coastal communities and their interactions and/or dependencies on menhaden.

The proposed time period for the study is three years. In the first year, data related to the commercial and recreational fisheries and communities were to be collected and compiled. In addition, existing peer-reviewed and gray literature related to the population dynamics and potential biological and physical roles of menhaden were to be reviewed. Also in the first year, community profiles were to be developed. In years 2 and 3, extensive economic models were to be developed and used to assess the economic importance and value of menhaden to residents of the Bay region. Alternatively, the economic value of the services of menhaden to the ecosystem was to be assessed in years 2 and 3.

In this brief report, we provide a summary of research activities in year 1 of the study. All and all, 12 tasks were to be completed in year 1 of the study; these 12 tasks are listed and accomplishments are discussed in the next section of this report. Tasks for years 2 and 3 are also listed in the next section; accomplishments towards completing these tasks, however, are not discussed in this summary report. A major undertaking of this research was the development of profiles of communities either affected by the population dynamics of menhaden or somehow directly dependent on menhaden for the social and economic well-being of the community. This required developing profiles for 42 counties and/or municipalities, which in some way or another depended upon menhaden or could be directly affected by changes in the population dynamics of menhaden. Reports on these profiles were previously submitted to the Virginia Marine Resources Commission (VMRC).

2.0 Summary of Year 1 Results

2.1 Overview of Research Results

Year 1 of the research project had 12 tasks (Table 2.1). For the purposes of better understanding the need for particular research to be conducted over time, we also include tables listing tasks for years 2 and 3 (Tables 2.2 and 2.3). We next summarize accomplishments of each of the 12 tasks identified for year 1.

Task 1: Reviewing Existing Literature of Physical, Biological, Social, and Economic relations between Key Species

It was discovered that there was a tremendous amount of both peer reviewed and gray (research reports) literature available dealing with menhaden. For the most part, however, the available literature was not conclusive about the exact importance of menhaden, particularly in the Bay region. Some literature indicated that menhaden were prey species (not necessarily the level of importance) for many species found in the Bay, while other literature indicated that menhaden preyed on zooplankton of major finfish and shellfish of the Bay (Durbin and Durbin, 1998). These conclusions seriously complicate drawing broad conclusions about the importance of menhaden as either a predator or prey species in the Bay. It is also widely stated that menhaden are extremely important to the diets of marine mammals and sea birds, but the majority of such statements or publications were neither peer reviewed nor prepared by scientists (e.g., H. Bruce Franklin who wrote the popular text "The Most Important Fish in the Sea: Menhaden and America" (2007) is not a scientist). We also found that sea birds and marine mammals consume menhaden, but no information was found documenting the importance of menhaden to the diet of sea birds and marine mammals (e.g., the Pew report (2004) "Menhaden Matter" states that "the lack of menhaden also could affect sea birds").

Recently, numerous representatives of recreational fishing associations and environmental groups have contended that menhaden contribute to enhanced water quality of the Bay. Alternatively, having lots of menhaden helps prevent water quality from deteriorating. Again, the Pew report, without scientific documentation, implies that menhaden, through their filter feeding process, maintain or enhance water quality. No scientific evidence, peer-reviewed literature, or sponsored research reports, however, supports this contention. In fact, some available literature contends the exact opposite—too large an abundance or biomass can cause a decline in water quality. The Chesapeake Bay Program, however, contends that menhaden are important for filtering the water and is an important prey species; this contention, however, is by a public statement and not supported research results. The National Coalition for Marine Conservation also state that menhaden are important for water quality, but again, offer no scientific evidence to support this contention. The bottom line is that there is inadequate research to demonstrate a relationship between water quality and the biomass or abundance of menhaden.

The commercial menhaden fishery is obviously important to the community and social well being of residents of Reedville. The fishery employs a substantial number of minorities while paying relative high salaries, as well as offering generous benefit packages. The community of Reedville, however, is but one small community of the Bay region, and as such, the community does not generate a lot of economic activity for the Commonwealth or Maryland. Reedville is located in Northumberland County, and is home to a large industrial fishery with processing capabilities. The economy of the Commonwealth in 2006 generated $622.0 billion in output or sales; $222.6 billion in employee compensation, and 4.8 jobs. In comparison, the economy of Northumberland County generated $477.5 million in output; 4,569 jobs, and $106.5 million in income; all of which is considerably less than the Economy of Virginia. Agriculture, forestry, and fisheries accounted for only $14.4 million in total sales; manufacturing accounted for $232.2 million in total sales in Northumberland. As such, the reduction fishery and facility is important to the economy and social structure of Reedville, but it is of less significance to the economies of the County and of the State. Previously, a large report was submitted to VMRC on the social and economic structures of the counties and communities potentially dependent upon menhaden or somehow affected by changes in the abundance or biomass of menhaden; the community profile report is 90 pages long.

Task 2: Review of on-going research to determine feasibility of applying results of such studies to this study to value menhaden

Existing studies on the economic value of ecosystem services could be used within either a benefit transfer approach or a meta analysis. Unfortunately, existing studies have not emphasized species like menhaden or the various functions or potential values of menhaden (e.g., water quality, recreational angling, water sports, etc.). Also, existing studies have illustrated that it is inappropriate to consider multiple values in an additive fashion as being representative of the total value (i.e., it is inappropriate to add all the individuals potential values of menhaden to obtain an estimate of the total value of menhaden).

Although existing studies were found to be mostly inapplicable for estimating the social and economic value of each ecosystem service of menhaden, it was determined that it is feasible to estimate the total and social economic value of menhaden using traditional stated preference methods. A survey is now under development.

Task 3: Design survey instruments for recreational and commercial fisheries related to menhaden, including the menhaden reduction fishery

Survey instruments were designed and field tested. These instruments request information about expenditures, angling, costs and earnings, and operational activities by the commercial facility. The actual surveys will be conducted in the present year (2009). Information collected, however, will be for calendar year 2008. Also, information on recreational activities will also be obtained from the National Marine Fisheries Service Recreational Survey; utilizing the NMFS data increases the number of observations and better facilitates the estimation of directed trips for major predators of menhaden.

The survey instrument for the commercial fishery is actually a questionnaire requesting basic information on plant and vessel activities, employment, social characteristics, costs and earnings, product distribution, and other related factors. OMEGA Protein has agreed to provide all requested information, unless otherwise viewed as being too proprietary or confidential to plant operations.

Task 4: Conduct survey of recreational anglers and commercial industry

A recreational survey was initially conducted on a limited scale in 2007 and early 2008. The results, however, were inconsistent with expectations. A limited follow up survey revealed that many individuals, especially non-coastal residents, were simply not familiar with menhaden or associated issues. They were being asked to place a value on something for which they knew very little. This raised the issue of the appropriateness of asking individuals not familiar with menhaden to place a value on menhaden vs. providing information related to the menhaden issues, which could bias results.

Since that early work, it has been determined that it is best to provide or educate potential respondents about the biological nature of menhaden; the perceived relationships to water quality, predators, and other potential links, as well as whether or not the relationship has been scientifically documented or is an untested hypothesis; and the issues related to menhaden. A new survey instrument has been developed and new surveys of recreational anglers and commercial sector will be conducted in early 2009.

Task 5: Develop product mix and market profile of reduction firm

The product mix was determined in both 2007 and 2008. OMEGA Protein, however, had major investments in new plant equipment in 2008, which requires that the most current plant mix be determined. OMEGA has agreed to provide additional information about product mix and relevant markets. In addition, OMEGA has an expanding health supplement business, which needs to be better described relative to the important of menhaden.

Task 6: Determine the communities in Maryland and Virginia perceived as having some dependency on menhaden (e.g., a community with a large charter fleet that primarily targets striped bass, blue fish, weakfish, or speckled trout, and of course, Reedville, Virginia)

Based on various reports, the Regional Economic Information System (REIS), statistical analysis, other sources of information, and the potential relationships between menhaden and water quality, it was determined that approximately 42 counties had some dependency or relationship to menhaden. The Maryland counties were as follows: (1) Anne Arundel, (2) The City of Baltimore, (3) Baltimore County, (4) Calvert, (5) Cecil, (6) Charles, (7) Dorchester, (8) Hartford, (9) Kent, (10) Prince George, (11) Queen Anne's, (12) Somerset, (13) St. Mary's, (14) Talbot, (15) Wicomico, (16) Worchester. The Virginia counties (or municipalities) were as follows: (1) Accomack, (2) Essex, (13) Gloucester, (4) Hampton, (5) Isle of Wight, (6) James City, (7) King and Queen, (8) King

George, (9) Lancaster, (10) Mathews, (11) Middlesex, (12) Newport News, (13) Norfolk, (14) Northampton, (15) Northumberland, (16) Portsmouth, (17) Poquoson, (18) Prince William, (19) Richmond, (20) Stafford, (21) Suffolk, (22) Surry, (23) Virginia Beach, (24) Westmoreland, (25) Williamsburg, (26) York.

Task 7: Develop community and county profiles (social and economic) of communities partially dependent on menhaden

Social and economic profiles were developed for all 42 counties (or municipalities). The profiles summarized the following: (1) basic nature or overview of county and social and economic structure; (2) incorporated and unincorporated towns in each county; (3) location; (4) transportation options and related aspects; (5) demographics; (6) educational attainment; (7) employment activities and types of employment; (8) income levels and distribution; and (9) housing and related information. A detailed description of the social and economic structure of Reedville, Virginia was also prepared. A 122 page report was submitted to VMRC in 2008, which contained the profiles of each of the counties or municipalities.

Task 8: Prepare detailed social and economic profile of employees of the reduction fishery, with an emphasis on dependency on the resource

Interviews were conducted with employees of OMEGA Protein in late 2007 with most being done in 2008. Information was collected on 34 questions asked during personal interviews of plant and vessel employees. These questions pertained to dependence of employee on OMEGA Protein; basic demographic information including educational attainment; other employment; benefits provided by OMEGA Protein; questions specific to job or work performed by individual; family size; and community related questions. Two major findings were as follows: (1) menhaden are not perceived as being socially or economically important for non-coastal residents; and (2) OMEGA Protein is important to both the social and economic structure of Reedville, Virginia, but less so for the county of Northumberland. Also, OMEGA Protein is viewed as an excellent source of employment for minorities and individuals lacking a college education; OMEGA, however, does also offer excellent employment opportunities, in terms of income and benefits, for individuals with a college degree.

Task 9: Host one workshops with national and international experts on non-market valuation, with the objective of determining the most appropriate methodology for estimating the economic value of the ecosystem services of menhaden (the actual selection of the valuation method will be done in year 2)

A three-day workshop was held in October of 2007. Individuals from numerous nations with experience in ecosystem-based management and the valuation of ecosystem services attended the meeting. All travel and related expenses were incurrent by the Virginia Sea Grant Advisory Program, Maryland Sea Grant, and NOAA Fisheries (Office of Science and Technology). Also in attendance were the Chief Scientist from NOAA

Fisheries and the Director of the Office of Science and Technology. The meeting was held at the Hall of States in Washington, D.C. It was concluded that both stated and revealed preference methods would be applicable to valuing the ecosystem services. A cautionary note, however, was developed regarding problems with comparing estimates from revealed preference analysis to results obtained via stated preference. It was agreed that comparisons should be strictly ordinal and not cardinal. It also was concluded that most existing studies on the value of ecosystem services had too many problems to be readily applied to valuing the ecosystem services of menhaden.   Another recommendation was to consider using EcoPath with EcoSim, mixed with an economics model, to assess the economic value of the ecosystem services of menhaden. The Eco-bas3ed models are off the shelf models to facilitate assessment of policies and simulate an ecosystem.

Task 10: Develop input/output models for the Virginia reduction fishery, and the recreational fisheries for striped bass, blue fish, speckled trout, and weakfish (Maryland and Virginia)

Input/output models for the commercial reduction fishery and the various recreational fisheries were developed for Maryland and Virginia and the various counties dependent or affected by menhaden.   These models were based on the technical relationships existing in 2006. They are now being updated to reflect the most recent period available, which is 2009. These models allow an assessment of the impacts in terms of total sales or output, total income, and total number of jobs generated via economic activity related to menhaden or recreational fisheries viewed as somehow being affected by resource characteristics of menhaden.

Task 11: Determine, in consultation with workshop participants, the appropriate valuation methodology for assessing the economic value or benefits of the ecosystem services of menhaden

Task 11 is somewhat redundant relative to Task 9, but more formally forces addressing the issue of selecting the valuation methodology, given existing information and knowledge. Given that the linkages between water quality, the underlying population dynamics, and menhaden are not known or well documented, it was concluded by experts attending the D.C. meeting that it would be best to attempt to simply determine or estimate the value placed on menhaden by residents of the Bay region. Alternatively, it was decided to seek a method to facilitate estimation of having the stock of menhaden higher than current levels or lower than current levels. That is, did society realize a higher economic value or gross benefit given high stock levels and satisfying certain conservation goals, or would society have a higher economic value from reduced stock levels but more economic activity in terms of jobs, sales or output, and generated income? Although not explicitly stated, this aspect of determining the valuation method was more about determining an approach to assess whether or not society preferred more or less menhaden to be harvested.

Additional follow up work had to be done to address this question because of the

discovery that many non-coastal residents (and actually a good number of coastal residents) knew very little or nothing about menhaden. This raised a theoretical issue about the validity of using results from a survey in which individuals were either not familiar with the related issues, or were provided extensive background information about the related issues and resource being valued. An expert panel, comprised of individuals from the D.C. meeting, recommended that information about the issues and related physical and biological concepts be provided, but in the case of uncertainty, note that the issue or concept is perceived to be the case and is not base on scientific evidence.

Task 12: Review literature and work with industry to determine appropriate valuation method for estimating the economic value of menhaden-based nutritional supplements (likely to be accomplished via revealed preference but has been done using stated preference/contingent valuation)

After consulting with several economists, who specialize in benefit cost analysis, it was concluded that the valuation of nutritional supplements would be accomplished via revealed preference analysis. That is, real market data would be used to assess the economic value of nutritional supplements. At the same time, it was argued that this approach would likely understate some aspects of the valuation because revealed preference does not adequately address nonmarket aspects, which may apply to nutritional supplements. Additional research was also initiated on reviewing the literature of the economic valuation of nutritional supplements to determine if a benefit transfer or meta analysis could be done. One problem identified with this assessment was that the majority of sales appear to be either outside the two states, or not really known at any geographic level of detail other than the United States. This is important because the study requires the social and economic impact and economic valuation assessments to be conducted for Bay area stakeholders and not across the United States. OMEGA Protein did, however, offer assistance to assess the distribution of product based on information available to them.

Table2.1 Tasks and projected time required to complete tasks, Year 1

Year 1/Task 1	Review existing literature on physical, biological, social, and economic relationships between keystone species (e.g., menhaden, water quality, population and health of striped bass, blue fish, speckled sea trout, weakfish, sea birds, and marine mammals)	4 mm Jkirkley (3) Ryan (1)
Task 2	Review of on-going research to determine feasibility of applying results of such studies to this study to value menhaden	1 mm Jkirkley (1)
Task 3	Design survey instruments for recreational and commercial fisheries related to menhaden, including the menhaden reduction fishery	3 mm Jkirkley (2) Ryan (1)
Task 4	Conduct survey of recreational anglers and commercial industry;	3.5 mm Jkirkley (0.5) Technician (3)
Task 5	Develop product mix and market profile of reduction firm	1 mm T.J. Murray
Task 6	Determine the communities in Maryland and Virginia perceived as having some dependency on menhaden (e.g., a community with a large charter fleet that primarily targets striped bass, blue fish, weakfish, or speckled trout, and of course, Reedville, Virginia)	5.5 mm Jkirkley (.5) Ryan (3) Taylor (2)
Task 7	Develop community and county profiles (social and economic) of communities partially dependent on menhaden	5 mm Ryan
Task 8	Prepare detailed social and economic profile of employees of the reduction fishery, with an emphasis on dependency on the resource	2.5 mm Jkirkley (0.5) Ryan (2)
Task 9	Host one workshop with national and international experts on non-market valuation, with the objective of determining the most appropriate methodology for estimating the economic value of the ecosystem services of menhaden	Workshop costs: Externally funded All planning, facilitating, etc. done by/Lipton/VIMS
Task 10	Develop input/output models for the Virginia reduction fishery, and the recreational fisheries for striped bass, blue fish, speckled trout, and weakfish (Maryland and Virginia)	4 mm Jkirkley (2)
Task 11	Determine in consultation with workshop participants the appropriate valuation methodology for assessing the economic value or benefits of the ecosystem services of menhaden	4 mm Jkirkley (1)
Task 12	Review literature and work with industry to determine appropriate valuation method for estimating the economic value of menhaden-based nutritional supplements (likely to be accomplished via revealed preference but has been done using stated preference/contingent valuation)	2 mm Jkirkley (2)

Table 2.2 Tasks and projected time required to complete tasks, Year 2

Year 2/Task 1	Complete development of input/output or impact models and assess associated economic impacts	4.5 mm Jkirkley (2.5)
Task 2	Complete social/economic profile of reduction fishery	.5 mm Murray (.5)
Task 3	Develop and field test appropriate survey instrument for determining the economic value of the ecosystem services of menhaden	5 mm Jkirkley (3) Technician (2)
Task 4	Develop list of stakeholders in Maryland and Virginia to survey for the purpose of determining the economic value of menhaden	4 mm Taylor (3) Technician (1)
Task 5	Develop stratified random sampling scheme to facilitate survey of Bay stakeholders;	1.5 mm Jkirkley (1.5)
Task 6	Conduct mail survey to obtain information necessary for estimating the economic value of the ecosystem services of menhaden	2.5 mm Jkirkley (.5) Technician (2)
Task 7	Prepare analytical data base using survey results	1.5 mm Technician (1.5)
Task 8	Develop mathematical/statistical models for estimating the value of the ecosystem services of menhaden relating to the potential attributes (e.g., water quality, prey for fish, and prey/diet for sea birds and marine mammals)	2 mm Jkirkley (2)
Task 9	The models will likely be random utility models requiring specifications consistent with multinomial logit models, and thus, the estimation algorithms will be developed	.5 mm Kirkley (.5)
Task 10	Estimate the economic valuation models and conduct sensitivity analysis	.5 mm Kirkley (.5)
Task 11	Using estimates from the economic valuation models, estimate the economic value of the ecosystem services of menhaden for the Bay region	1.5 mm Kirkley (1.5)

Additional	Collaborating Investigators:
	   Hicks
	   McConnell
	   Strand
	   Duberg
	Maryland Marine Advisory Services Program
	   Lipton
	Surveys of stakeholders: 4,000 @ $2.50
	Student
		
		Assist in tasks 3, 5, and 7-11
		"
		"
		Task 1
		Tasks 3-5 and 8-11
		
		All Tasks

Table 2.3 Tasks and projected time required to complete tasks, Year 3

Year 3/Task 1	Update menhaden production distribution assessment	1 mm Murray (1)
Year 3/Task 2	Complete comprehensive assessment of the social and economic impacts and value of menhaden to Bay region	6 mm Kirkley (4)
Task 3	Complete draft report of assessment of social and economic impacts and economic value	7 mm Kirkley (4)
Task 4	Submit to VMRC and other appropriate entities for comments and suggestions	.25 mm Kirkley (.25)
Task 5	Based on reviews and comments, prepare and submit final report to VMRC and other appropriate agencies	5.75 mm Kirkley (3.75)

Additional	Collaborating Investigators:
	    Hicks
	    McConnell
	    Strand
	Maryland Marine Advisory Services Program
	    Lipton
	Student
		
		Assist in tasks 2,3 and 4
		"
		"
		Tasks 2,3 and 4
		
		All Tasks

3.0 Summary and Conclusions

3.1 Summary and Recommended Modifications to Study

In year 1 of the study, all 12 tasks were completed. Most important among these tasks were the determination of the methods to assess the economic value, and assessment of the social importance of menhaden to various counties of the Bay region. In addition, profiles for 42 counties or municipalities in Maryland and Virginia either dependent upon or some related to menhaden were developed. It was readily assessed that menhaden were important to Reedville, Virginia, but much less so to the other counties and municipalities of the region. Moreover, it was discovered that many individuals outside of coastal counties were not familiar with menhaden or related issues.

Since the primary focus of the valuation work is on determining the economic value or benefits of the ecosystem services of menhaden, it became apparent that stated preference would have to be used to conduct such an assessment. Standard input/output modeling, based on IMPLAN, was determined to be appropriate for estimating the economic impacts or contributions of menhaden to the economies of the Bay region. State preference was selected because it is generally acceptable to many economists concerned with estimating the benefits or economic value of nonmarket goods and services, which is the case for the ecosystem services of menhaden.

3.2 Recommendations

It also was determined, however, that survey results based on 07 responses or activities would not be appropriate for providing representative values and impacts. This was primarily because respondents were not familiar with menhaden. Even, or possible even more so, estimates based on 2008 activities will also be extremely limited. This is because of major increases in fuel prices in the first half of 2008 and declines in economic activity in the second half of 2008. In simple terms, economic activities in 2007 and 2008 are not likely indicative of representative activities by either recreational anglers or the commercial sector. Moreover, OMEGA Protein had major investments in plant and equipment in 2008, and it would be more appropriate to use economic activity by OMEGA in 2008 to estimate the economic importance of OMEGA Protein to the economies of the region.

To a large extent, not enough economic studies have been done to apply the benefit transfer approach or to conduct a meta analysis to estimate the economic value of menhaden, either in terms of its ecosystem services or in terms of its direct use. Original surveys were determined to be necessary to determine the economic value and impacts of menhaden, and these are now being conducted.